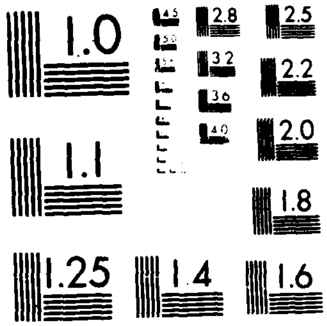
AD-A179 258 ATMOSPHERIC RADIANCE PROFILE CODES(U) UTAH STATE UNIV LOGAN CENTER FOR SPACE ENGINEERING B K YAP 17 SEP 86 CSE/86-120 AFGL-TR-87-0009 F19628-83-C-0056 1/1

UNCLASSIFIED F/G 4/1 NL



MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS

DTIC FILE COPY

(12)

AFGL-TR-87-0009

AD-A179 258

ATMOSPHERIC RADIANCE PROFILE CODES

B.K. Yap

Yap Analytics, Inc.
594 Marrett Road
Lexington, MA 02173

The work reported herein was performed under subcontract to
Center for Space Engineering
Utah State University
Logan, Utah 84322-4140

Scientific Report No. 19

17 September 1986

Approved for public release; distribution unlimited.

AIR FORCE GEOPHYSICS LABORATORY
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
HANSCOM AIR FORCE BASE
MASSACHUSETTS 01731

"This technical report has been reviewed and is approved for publication"

(Signature)
FRANCIS X. ROBERT
Contract Manager

(Signature)
RANDALL E. MURPHY, Acting Chief
Atmospheric Backgrounds Branch

FOR THE COMMANDER

(Signature)
RANDALL E. MURPHY, Director
Infrared Technology Division

This report has been reviewed by the ESD Public Affairs Office (PA) and is releasable to the National Technical Information Service (NTIS).

Qualified requestors may obtain additional copies from the Defense Technical Information Center. All others should apply to the National Technical Information Service.

If your address has changed, or if you wish to be removed from the mailing list, or if the addressee is no longer employed by your organization, please notify AFGL/DAA, Hanscom AFB, MA 01731. This will assist us in maintaining a current mailing list.

Do not return copies of this report unless contractual obligations or notices on a specific document requires that it be returned.

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

A179258

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY 2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.
4. PERFORMING ORGANIZATION REPORT NUMBER(S) CSE/86-120	5. MONITORING ORGANIZATION REPORT NUMBER(S) AFGL-TR-87-0009
6a. NAME OF PERFORMING ORGANIZATION Center for Space Engineering Utah State University 6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION Air Force Geophysics Laboratory
6c. ADDRESS (City, State and ZIP Code) UMC 4140 Logan, UT 84322	7b. ADDRESS (City, State and ZIP Code) Hanscom Air Force Base Bedford, MA 01731
8a. NAME OF FUNDING/SPONSORING ORGANIZATION Air Force Geophysics Lab 8b. OFFICE SYMBOL (If applicable) LSP	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER F19628-83-C-0056
8c. ADDRESS (City, State and ZIP Code) Hanscom Air Force Base Bedford, MA 01731	10. SOURCE OF FUNDING NOS. PROGRAM ELEMENT NO.: 62101F PROJECT NO.: 7670 TASK NO.: 10 WORK UNIT NO.: AK
11. TITLE (Include Security Classification) Atmospheric Radiance Profile Codes	

12. PERSONAL AUTHOR(S)
B.K. Yap

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Yr., Mo., Day)	15. PAGE COUNT
Scientific No. 19	FROM ______ TO ______	86/09/17	46

16. SUPPLEMENTARY NOTATION
The work reported herein was performed under subcontract to Center for Space Engineering.

17. COSATI CODES		
FIELD	GROUP	SUB. GR.

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
ELIAS, CYBER, APOLLO, atmospheric codes, radiance profiles data reduction

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This report presents and describes the computer codes which Yap scientists developed to generate atmsopheric radiance profiles for various molecules, species, and rotational bands. Yap researchers extracted radiance profiles from the standard NLTE program output files and transferred them from the Cyber system to the Apollo system. ~~Yap~~'s efforts include a routine to plot the radiance profiles' sum total and SPIRE program measured data.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS ☐	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL Francis X. Robert/AFGL	22b. TELEPHONE NUMBER (Include Area Code) (617) 861-3641 22c. OFFICE SYMBOL LSP

DD FORM 1473, 83 APR — EDITION OF 1 JAN 73 IS OBSOLETE.

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

FOREWORD

The Earth Limb Infrared Atmospheric Structure (ELIAS) experiment served as a test round for the SPIRIT program (SPIRIT recorded infrared measurements of auroral and earth-limb emissions using sensors mounted on a sounding rocket). ELIAS consisted of a three-channel scanning radiometer aboard a high-altitude sounding rocket. Scientists launched the ELIAS payload on 18 March 1983.

CSE awarded Subcontract No. 85-060 to Yap Analytics, of Lexington, MA obligating them to develop a statistical analysis and characterization of the ELIAS experimental data. Yap scientists completed their work under this subcontract and submitted their final report to CSE in December, 1985.

This report presents and describes the computer codes which Yap scientists developed to generate atmospheric radiance profiles for various molecules, species, and rotational bands.

SUMMARY

Yap scientists successfully debugged and tested the infrared atmosphere vibrational temperature code, RADT. They revised the code to make it flexible for various applications and then cascaded it with the Non-Equilibrium Atmospheric code, NLTE. The researchers then established procedures to use the combined codes to generate vibrational temperature profiles and radiance profiles for various molecules, species, and rotational bands. Codes were than generated to extract the radiance profiles from the standard NLTE program output files and transfer them from the Cyber system to the Apollo system. Finally, Yap created a routine to plot the radiance profiles' sum total and SPIRE program measured data.

This page intentionally left blank.

TABLE OF CONTENTS

This page intentionally left blank.

LIST OF FIGURES

1. INTRODUCTION

The ELIAS experiment called for launching a rocket-borne complement of infrared sensors into aurorally active skies from Poker Flat Research Range in Alaska, while ground observers simultaneously recorded the auroral activity at Watson Lake, Fort Nelson, Peace River, and Fort Providence, Canada. The prime sensor aboard the ELIAS payload was a telescoped, liquid-nitrogen-cooled scanning radiometer (NTR-1). This radiometer detected infrared radiation at 9100Å and in the SWIR and MWIR spectral regions.

During the ELIAS mission, all sensors operated as expected and the experiment provided excellent data. The ELIAS mission also verified the feasibility of pointing an infrared sensor manually with a hand-operated "joystick".

This report describes the computer codes that Yap developed to generate the atmospheric radiance profiles for various species and rotational bands of a given molecule. This report also describes the procedures which Yap established to streamline the various codes. The appendix contains listings of the codes and procedures.

This page intentionally left blank.

2. OVERALL FLOWCHART

Several steps are involved in the generation of the final plot of the theoretically computed infrared radiance versus altitude for the various species. Figure 1 is an example of the final product. Included in the plot are data points measured on the AFGL SPIRE program. The radiance axis is in Watt/Cm^2-Sr-Band, and the tangent height is in Km. Species data were computed and illustrated together with the sum total radiances of these species.

Figure 2 shows a general flowchart of the procedures. Six major procedures constitute the production of the final plot. The first four procedures are performed on the AFGL Cyber system where the major computer codes reside. A transfer of the output file is then made from the Cyber to the Apollo system, where the final plotting of the band radiance profiles are then performed.

The first procedure, 'BOTH', involves two major sets of codes, as will be described in detail in a later section. The two codes are entitled 'NLTE4' and 'RADT'. The main product of the procedure 'BOTH' is a file 'SPIREF' containing the vibrational temperature versus altitude of a particular band and branch (e.g. CO_2, Q branch). This procedure is generally repeated four or more times to assure computation convergence.

The vibrational temperature profile is then fed into a code in the procedure 'FIXSPIR' from which the hot band vibrational temperature profile 'SPIREH' is extracted.

The next procedure, "JOB#', is processed eleven times, once per specie to obtain the infrared radiance profile for each specie. Eleven procedures labelled 'JOB1', ..., 'JOB11' have been set up to perform the computations for each of the species.

The eleven output files from the 'JOB#' procedures are then streamed into the procedure 'PLTFILE' which extracts just the band radiance profiles from each file and reformats them in a concise file called 'XXOUT' for plotting.

At this point, the reformatted radiance profiles in file 'XXOUT' are transferred from the Cyber system to the Apollo system through the high rate NIU network, and stored under the file name 'CO2DATA1'. In the Apollo, a plot routine has been formulated to accept the file containing the radiance profiles, and to plot each radiance profile with the total radiance, as well as the AFGL SPIRE program measured data.

3. PROCEDURE 'BOTH'

Procedure 'BOTH' utilizes two major AFGL computer codes - NLTE4 (Non-Equilibrium Atmospheric Code) and RADT (Vibrational Temperature Profile Code). Both codes are resident in the AFGL Cyber system and may be accessed upon request.

Figure 3 shows the flowchart for Procedure 'BOTH'. The description and use of the NLTE computer code may be found in the document AFGL-TR-83-0168. NLTE4 is a modified version of NLTE; it provides a single line profile as an additional output file. The input file formats for Units 1-3 remain unchanged from those described in the AFGL document. Table 1 is a sample of Unit 1's input file format. In Card 1C, the fifth and seventh parameters (computation accuracy and wing integration) must be set to zero to obtain a complete output file for the single line profile.

The atmospheric profile for Unit 2 and the AFGL line profile for Unit 3 are also described in the above-mentioned AFGL document. These may be created by following the descriptions in the document. Once created, they must be stored under file names 'SPIREF' and 'CO215MI' respectively, to be accessed by the NLTE4 program code.

The single line profile at the output of Unit 7 is stored under the file name 'ZINPRAD'. This file is retrieved automatically by the 'BOTH' procedure to be used on Unit 8 as one of the inputs to the 'RADT' code.

Program inputs to 'RADT' on Unit 1 are illustrated in Table 2. Card 1A is read in with format 'A1' and the two permitted line profiles are either the Voight ('V') or the Doppler ('D'). Card 1B is read in with format 'A5' and the two permitted methods of computing the upwelling radiance from below are either the blackbody ('BBODY') or FASCODE ('FCODE'). Card 1C is read in with format 'A1' and the permitted line branches are 'P', 'Q', or 'R'.

Unit 4 input to RADT is the 'SPIREF' file containing the atmospheric profile which is read in with the format described for Unit 2 input to NLTE4. This

file is stored under file name 'OLDSPIR' upon completion of the process. This permits a comparison of the input file 'OLDSPIR' with the new atmospheric profile 'SPIREF' at the output on Unit 7, to test for computation convergence. The atmospheric line profile input on Unit 5 is named 'DATAF'. Table 3 describes Unit 5 input formats. An additional input record (1a) is required if the choice for computing the upwelling radiance from below is 'FCODE'. In this instance, a second temperature (T2) and a distance from the line center (N2) must be inserted as the first input record.

An updated atmospheric vibrational temperature profile is generated on Unit 7 as output of this procedure. Its format is identical to that of input file 'SPIREF' on Unit 4. At the end of the procedure, this file replaces the file 'SPIREF'. In general, this entire procedure is cycled at least four times to assure convergence in the computation of the vibrational temperature profile. Test of computation convergence may be verified by comparing the previous file 'OLDSPIR' with the new file 'SPIREF'. An example of the program's computational convergence is illustrated in Figures 4-5. In Figure 4, the difference between the vibrational temperature profiles from runs 2 and 1 are depicted as a precentage of the vibrational temperature profiles from run 4. Less than 0.03% difference was observed at low altitudes, while at high altitudes the difference is well below that. In Figure 5 the difference obtained from runs 4 and 3 were again shown as a percentage of that from run 4. Computational convergence over the entire altitude range is evident in the figure.

The procedure is assembled as a local file 'B' which is listed in Table 4. To use procedure 'BOTH', the following instruction is entered on an interactive terminal: BEGIN,BOTH,B.

4. PROCEDURE 'FIXSPIR'

The flowchart for procedure 'FIXSPIR' is shown in Figure 6. The vibrational temperature profile 'SPIREF' obtained from cycling through procedure 'BOTH' (at least four times) is placed on Unit 10 as input to the Hot Band Vibrational Temperature computer code 'FIXSPIR'. The code generates an output file 'SPIREH' on Unit 20. In addition to a header record, 'SPIREH' contains records of the hot band profile, as Table 5 illustrates.

The format for these records is (F5.0,F10.3,5E12.5). A listing of the local file 'FIX' containing procedure 'FIXSPIR' is in Table 6.

To exercise procedure 'FIXSPIR', the following instruction is entered on an interactive keyboard: BEGIN,FIXSPIR, FIX.

This page intentionally left blank.

5. PROCEDURE 'JOB#'

Procedure 'JOB#' (where # = 1,.....,11) utilizes the computer code 'NLTEE' which is an updated version of Non-Equilibrium Atmosphere Code 'NLTE'. 'NLTEE' was revised to replace the Simpsons' integration in 'NLTE' with Gaussian integration. Because of the Lorentzian roll-off of the line profile, the Gaussian integration permits progressively coarser sampling over the wings of the line profile, thus resulting in a tremendous time improvement in running the code. Aside from this improvement, input requirements and formats are identical to those of 'NLTE'. The flowchart for the procedure is shown in Figure 7. One of the following AFGL line profiles are used for input on Unit 3 for each of the eleven successive runs:

1. 'C0215MI'	7. 'C02626'
2. 'C0215MI'	8. 'C02626'
3. 'C0215MI'	9. 'C02DATA'
4. 'L010000'	10. 'C02DATA'
5. 'C02626'	11. 'C02DATA'
6. 'C02626'	

For runs 1 through 4, the atmospheric profile 'SPIREF' is used as input on Unit 2. For the hot-band computations of runs 5 through 11, the file 'SPIREH' is the input on Unit 2.

The band radiance profile is outputted on Unit 5 with the following format: (F7.3,A3,2I4,5(I4,E10.4,E9.3)) following header records. Table 7 lists the output parameters on Unit 5. The last four parameters (LBND, LMAX, SUMRD, TOD) are written five times per record.

The output files from Unit 5 for each of the eleven runs are stored respectively as:

1. 'T562601'	7. 'T562611'
2. 'T563601'	8. 'T562612'
3. 'T562801'	9. 'T56261'
4. 'T562701'	10. 'T56262'
5. 'T562603'	11. 'T56302'
6. 'T562602'	

Table 8 lists the local file 'B#' (where # = 1,2,....,11) which contains the procedure 'JOB#' (# = 1,....,11). To process each of the 'JOB#' procedures, the following command is entered via an interactive keyboard: BEGIN,JOB#,B#.

6. PROCEDURE 'PLTFILE'

In the 11-Band Radiance Profile Conversion Code 'READFL' contained in the procedure 'PLTFILE', the eleven band outputs from the procedure 'JOB#' are converted into a concise file suitable for plotting. Each file, ('T562601',.. ..'T563602') is sequentially read in on Unit 10. Figure 8 is the flowchart for the procedure. 'READFL' searches for the band radiance for each altitude from each file. When all eleven files have been processed, 'READFL' writes the eleven band-radiance profiles out on Unit 20. At the termination of procedure 'PLTFLE', the radiance profile is stored under file name 'XXOUT'.

A listing of the local file 'PLTFLE' containing the procedure 'PLTFILE' is in Table 9. To generate the concise radiance profile with procedure 'PLTFILE', the following command is entered via keyboard on an interactive system: BEGIN,PLTFILE,PLTFLE.

This page intentionally left blank.

7. CYBER TO APOLLO

A plot routine has been coded in Fortran on the Apollo system specifically to plot the band radiance profiles together with their sum and Spire program measured data. The concise plot file has to be transferred from the Cyber to the Apollo system through the communication network (NIU). The plot file is short and takes a matter of seconds once the link has been established between the Cyber and the Apollo. The plot file on the Cyber 'XXOUT' is retrieved and transferred to the Apollo and stored under the file name 'CO2DATA1' (see Figure 9). The file 'CO2DATA1' should be stored in the following directory: '/USERS/LSP/BANKS' since the plotting package and necessary inputs to the plot package are in the same directory.

This page intentionally left blank.

8. APOLLO PLOT ROUTINE

Figure 10 illustrates the plotting procedure on the Apollo system. Unit 8 contains the computed data file transferred from the Cyber. The Unit 9 input file contains the Spire program measurement data as well as other plot initialization data.

The plotting program 'co2' is compiled and stored under file name 'BOBEEP'. When 'BOPEEP' is executed, both input files are read and the plotting coordinates are set up. The total radiance of the eleven bands is computed. The twelve curves are then plotted within the confines of the setup coordinates.

The plot routine on the Apollo is stored in the directory of '/USERS/LSP/BANKS'. To execute the plot routine, the following instruction is entered while working in the above directory: 'BOPEEP'.

An output file named 'DATA_PLOT_FILE.01' is generated after the screen plotting is complete. A hard copy of this plot may be obtained with the following instructions: PRF -NPAG DATA_PLOT_FILE.01.

It is advisable to delete the stored plot to free up disk space after the hard copy is obtained. The following instruction is entered:
DLF DATA_PLOT_FILE.01.

This page intentionally left blank.

FIGURES AND TABLES

This page intentionally left blank.

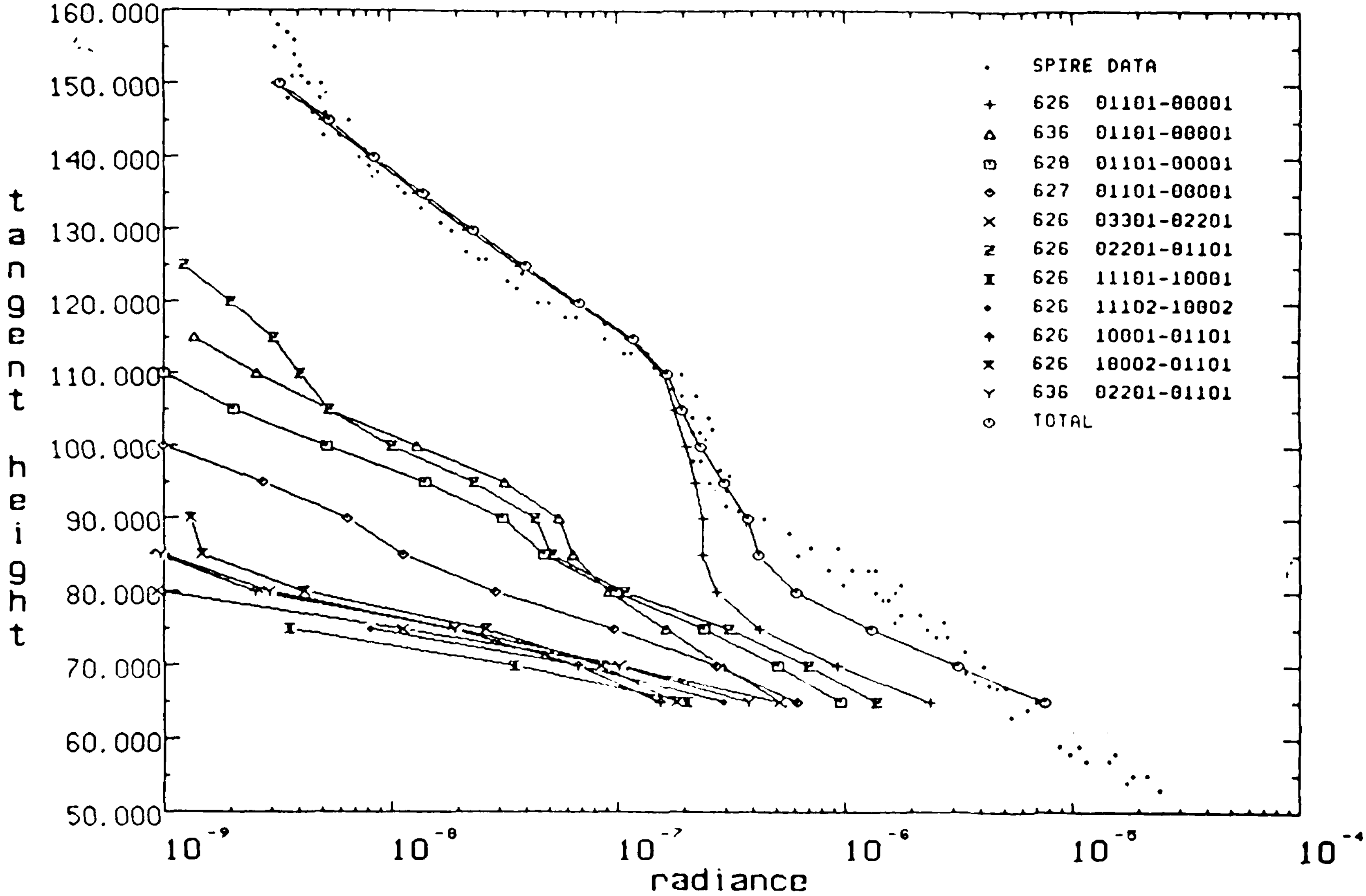


Figure 1. **CARBON DIOXIDE RADIANCE PROFILE**

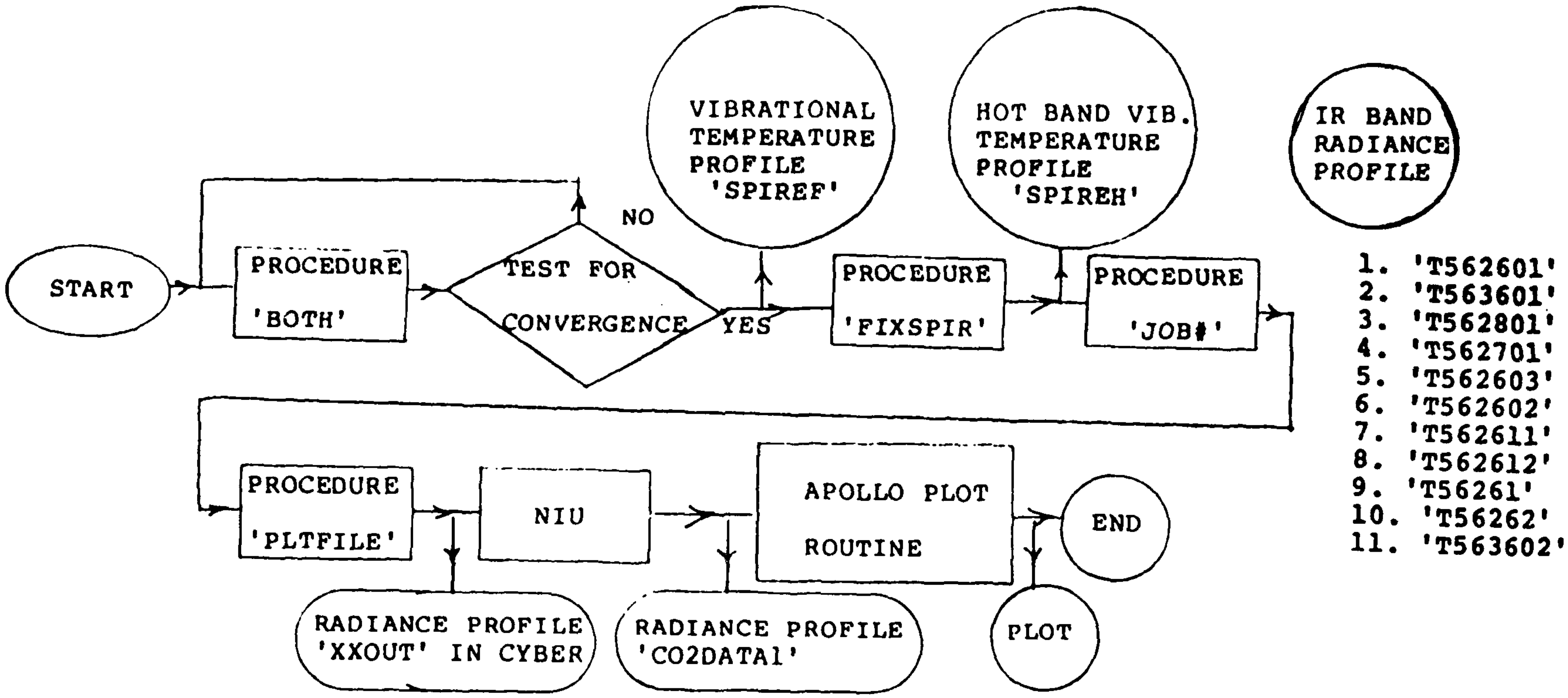


Figure 2. Overall Flowchart.

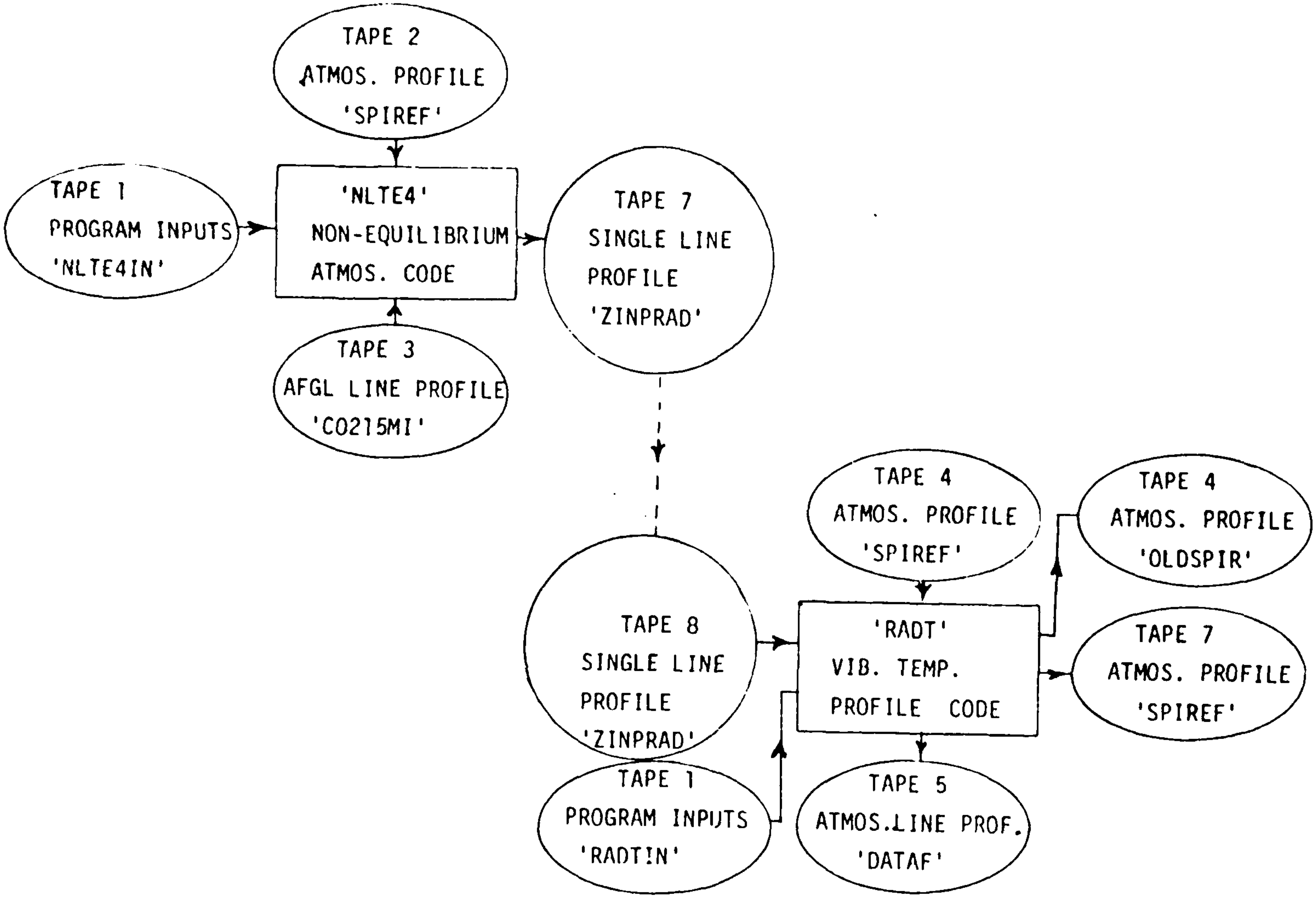


Figure 3. Flowchart for Procedure 'BOTH'

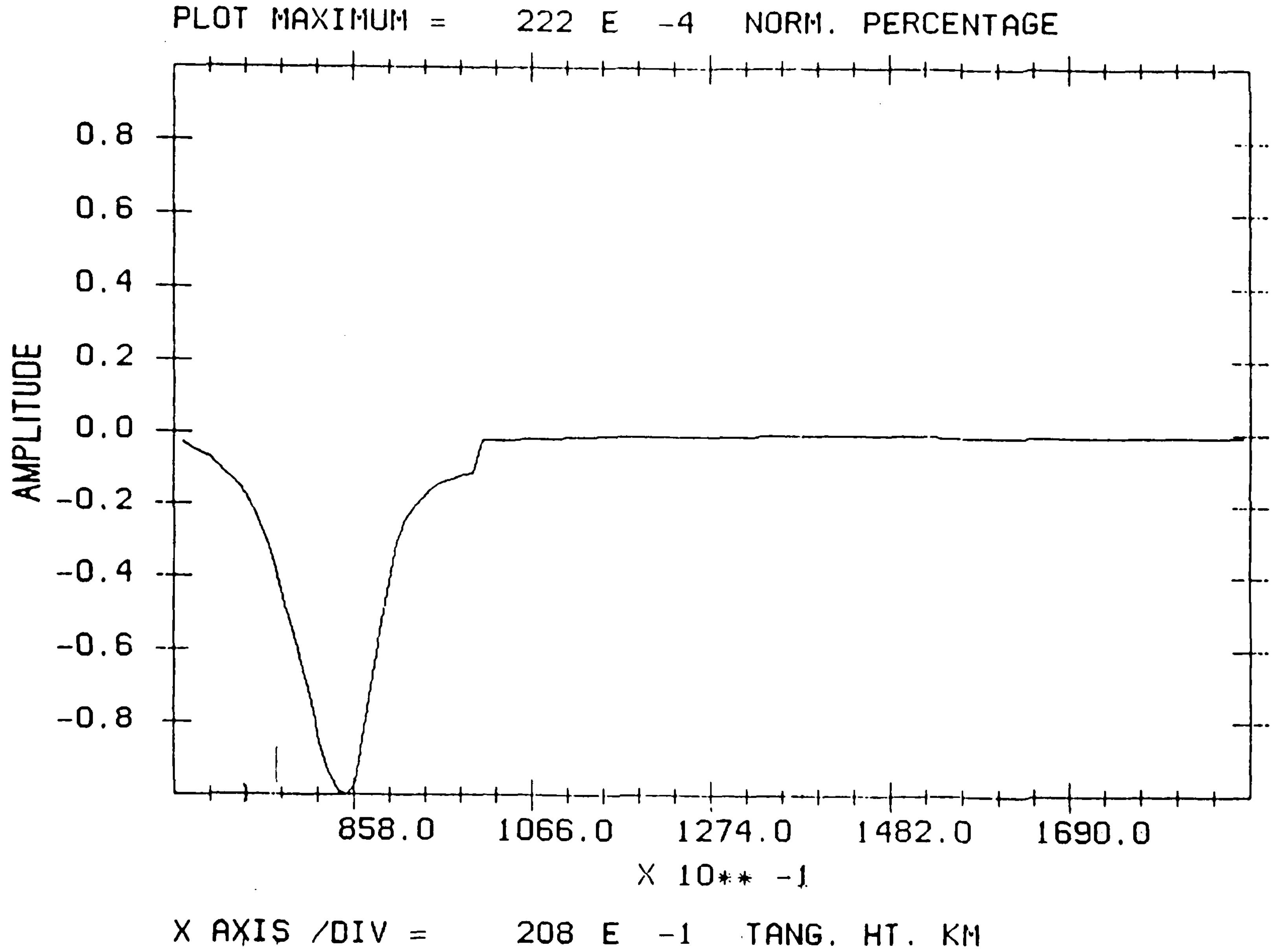


Figure 4. *NORM. % OF (SPIREF2-SPIREF1)/SPIREF4*

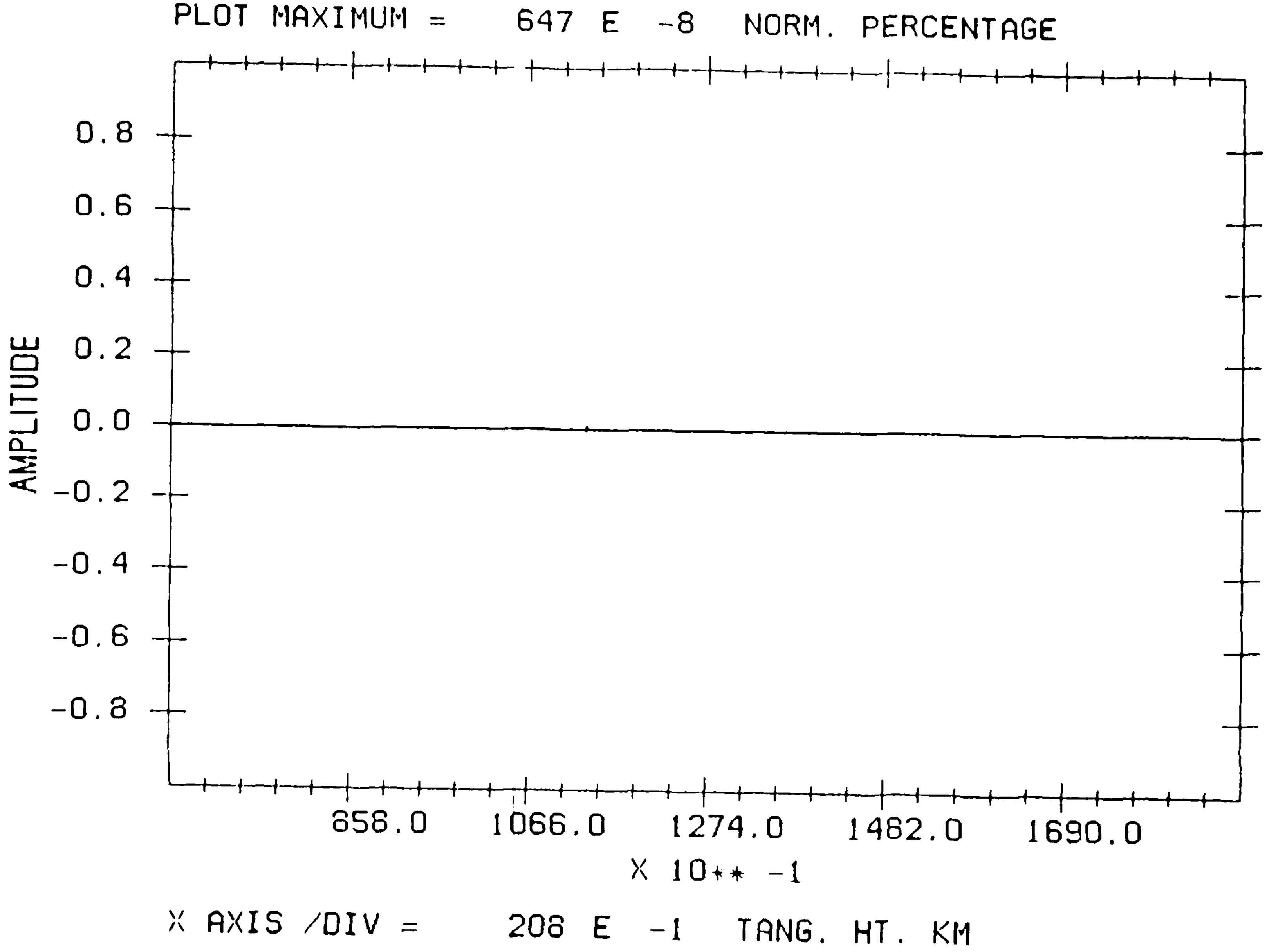


Figure 5. *NORM. % OF (SPIREF1-SPIREF3)/SPIREF4*

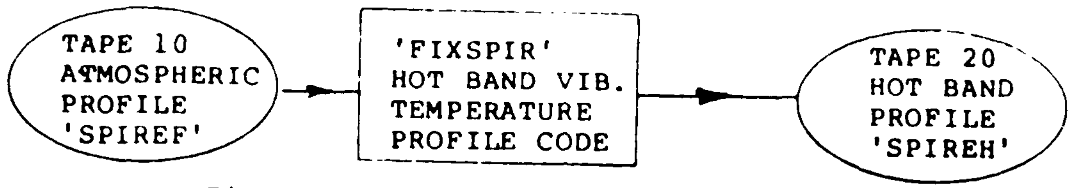


Figure 6. Flowchart of Procedure 'FIXSPIR'

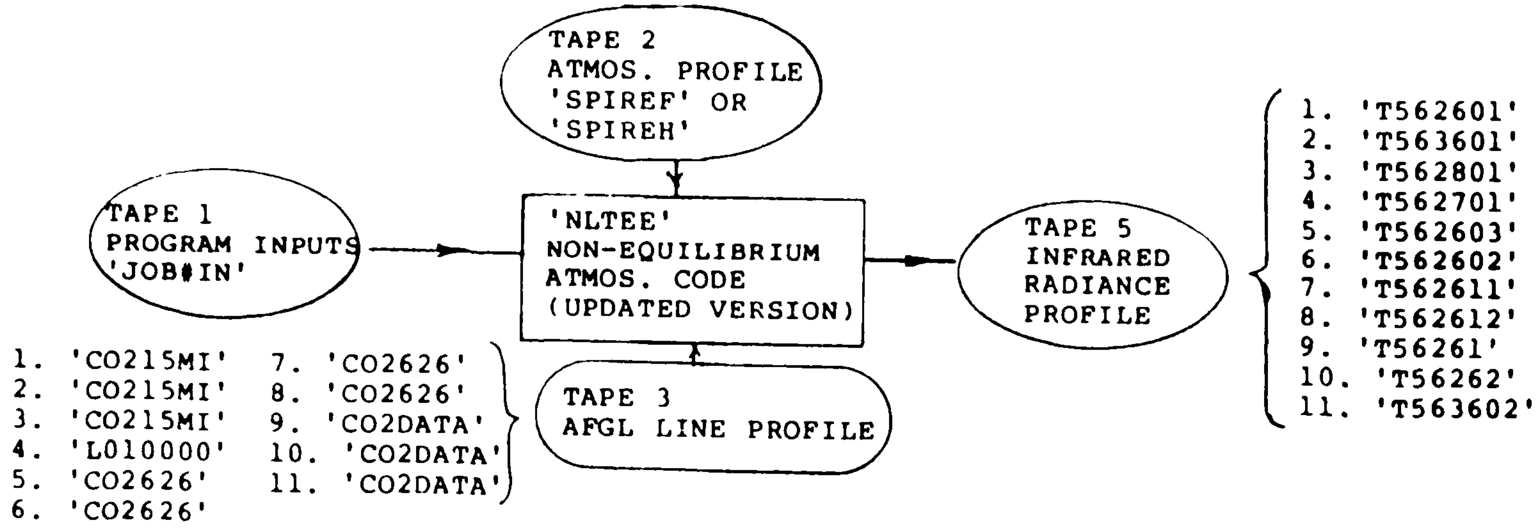


Figure 7. Flowchart of Procedure 'JOB#'.

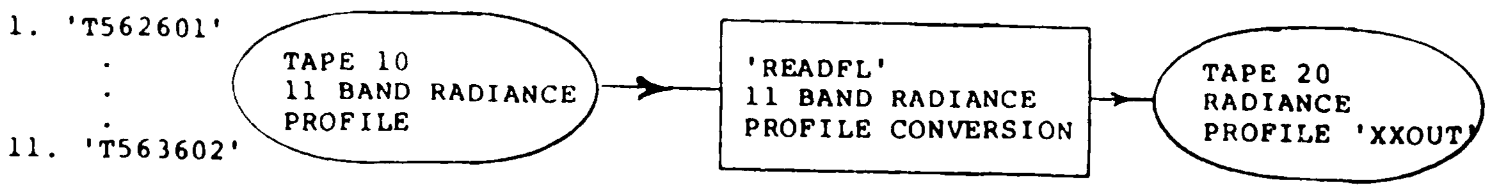


Figure 8. Flowchart of Procedure 'PLTFILE'.

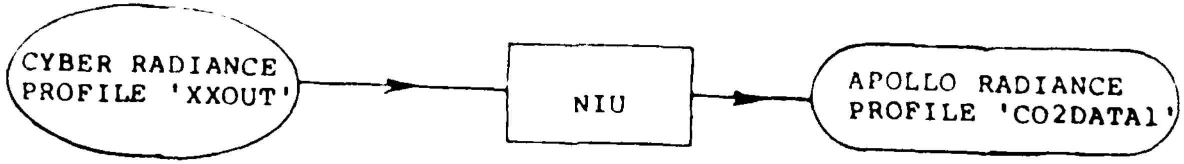
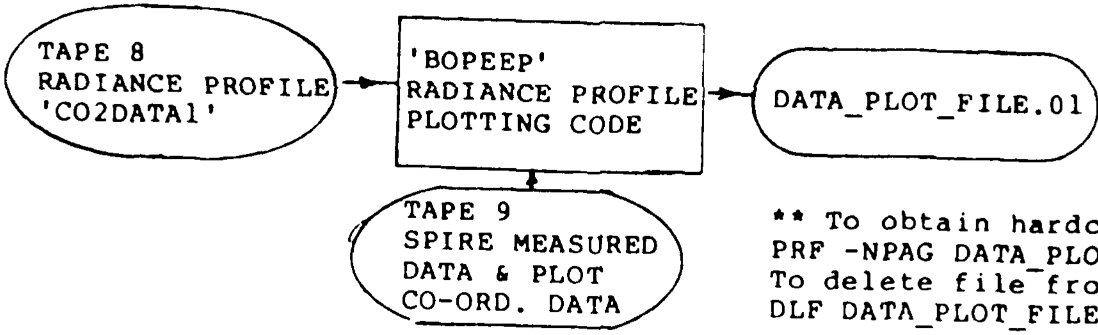


Figure 9. Flowchart of Cyber to Apollo Transfer.



** To obtain hardcopy enter:
PRF -NPAG DATA_PLOT_FILE.01
To delete file from directory:
DLF DATA_PLOT_FILE.01

Figure 10. Flowchart of Apollo Plot Routine.

Table 1 Program Inputs on Unit 1

Quantity	Description	Unit	Type	Example
(Card 1A)				
MOL	Molecular Formular		Character	'CO2'
ISO	Isotope code		Integer	626
VIBE	Vib energy of the transition	cm^{-1}	Real	667.379
VIBL	Vib energy of lower state	cm^{-1}	Real	0
VIBQ	Vib energy for partition fn	cm^{-1}	Real	667.379
(Card 1B)				
BR	Branch (P,Q, or R)		Character	'Q'
NRQL	Rotational quantum line		Integer	30
UST	Upper vib state (AFGL not 'n)		Character	'01101'
LST	Lower vib state (AFGL not 'n)		Character	'00001'
NDP	Lineshape option		Integer	0
VMIN	Lowest wavenumber desired	cm^{-1}	Real,int	600
VMAX	Highest wavenumber desired	cm^{-1}	Read,int	750
(Card 1C)				
TANIN	Initial tangent height	km	Integer	65
TANF	Final tangent height	km	Integer	100
INTRVL	Examination height	km	Integer	5
HMAX	Altitude of top layer	km	Integer	150
ACC	Fractional error		Real	0
NPTS	Number of integration points		Real	
WING	Wing cutoff		Real	0

Example of an Input Data Record on Unit 1

```
'CO2',626,667.379,0,667.379/
'Q',30,'01101','00001'/
65,100,-1,150,0,,0/
0
```

Table 2. RADT Program Inputs on Unit 1.

Quantity	Description	Unit Type	Example
(CARD 1A)			
IANSWER	Line profile	Character	'V'
(CARD 1B)			
METHOD	Method of radiance computation	Character	'BBODY'
(CARD 1C)			
IB	Branch of spectral line	Character	'Q'

Example of an Input Data Record on Unit 1 for RADT

```
'V'
'BBODY'
'Q'
```

Table 3. Atmospheric Line Profile on Unit 5.

Quantity	Description	Unit	Type	Example
(RECORD 1a)	****** Required when option is FCODE ******			
T2	Second Temperature	Deg K	Real	
N2	Distance from Line Center	cm^{-1}	Real	
(RECORD 1)				
AE	Einstein Coefficient		Real	
ROTCON	Rotational Constant		Real	
STWR	Stat. Weight for Rot. Line		Real	
QAL	Non zero if Q Branch allowed		Real	
STU	Stat. Wt. for Upper Vib. Level		Real	
STL	Stat. Wt. for Lower Vib. Level		Real	
(RECORD 2)				
T1	Initial Temperature	Deg K	Real	
DW	Doppler Width	Cm^{-1}	Real	
S	Absorption Coefficient	Cm/Part.	Real	
FNU	Line Center	Cm^{-1}	Real	
H1	Initial Altitude	Km	Real	
ROT	Rotational Quantum #		Real	
(RECORD 3 - N)				
H(N)	Lower Altitude	Km	Real	
T(N)	Lower Temperature	Deg K	Real	
C(N)	Lower CO_2 Density	Part./CC	Real	
A(N)	Lower N_2 Density	Part./CC	Real	
B(N)	Lower O-Atom Density	Part./CC	Real	
CT(N)	Lower O_2 Density	Part./CC	Real	

Table 4. Listing of File 'B' with Procedure 'BOTH'.

```
.PROC,BOTH.
GET,LGO=NLTE4B
GET,TAPE1=NLTE4IN.
GET,TAPE2=SPIREF.
GET,TAPE3=CO215MI.
REWIND,TAPE1,TAPE2,TAPE3,OUTPUT,LGO.
ASSIGN,MS,OUTPUT.
LGO.
ASSIGN,TT,OUTPUT.
REWIND,TAPE7.
REPLACE,TAPE7=ZINPRAD.
RETURN,LGO,TAPE1,TAPE2,TAPE3,TAPE7,TAPE5,TAPE4,TAPE6.
GET,LGO=RADTB.
GET,TAPE1=RADTIN.
GET,TAPE4=SPIREF.
GET,TAPE5=DATAF.
GET,TAPE8=ZINPRAD.
REWIND,TAPE1,TAPE4,TAPE5,TAPE8,LGO,OUTPUT.
ASSIGN,MS,OUTPUT.
LGO.
ASSIGN,TT,OUTPUT.
REWIND,TAPE7.
REPLACE,TAPE7=SPIREF.
REPLACE,TAPE4=OLDSPIR.
RETURN,TAPE1,TAPE4,TAPE5,TAPE7,TAPE8,LGO.
```

Table 5. Hot Band Profile 'SPIREH'.

Quantity	Description	Unit	Type	Example
ALT	Altitude	Km	Real,int.	
TRTMP	Translational Temperature	Deg K	Real	
PRESS	Atmospheric Pressure	Atmos.	Real	
RHO	# Density of Rad. Mole.	Cm^{-3}	Real	
TVL	Lower Level Vib. Temp.	Deg. K	Real	
TVU	Upper Level Vib. Temp.	Deg. K	Real	
TVQ	Lowest Excited State Vib. Temp.	Deg. K	Real	

Table 6. Listing of Procedure 'FIXSPIR'.

```
.PROC,FIXSPIR.
GET,FIXSPB.
GET,SPIREF.
REWIND,FIXSPB,SPIREF.
FIXSPB.
REWIND,SPIREH.
REPLACE,SPIREH.
GET,YY=FIXSPIR.
RETURN,FIXSPB,SPIREF,SPIREH.
```

Table 7. Radiance Profile Output on Unit 5.

Quantity	Description	Units	Type	Sample
TS			Real	
BR(J)	Branch		Character	
RQL			Integer	
LBND	Band		Integer	
LMAX			Integer	
SUMRD	Integrated Radiance	W/CM^2-Sr	Real	
TOD				

Table 8. Listing of 'B#' containing procedure 'JOB#'.

```
.PROC.JOB1.
GET,TAPE1=JOB1IN.
GET,TAPE2=SPIREF.
GET,TAPE3=CO215MI.
GET,LGO=NLTEEB.
REWIND,LGO,TAPE1,TAPE2,TAPE3,OUTPUT.
ASSIGN,MS,OUTPUT.
LGO.
ASSIGN,TT,OUTPUT.
REWIND,TAPE5,TAPE6,TAPE7,OUTPUT.
REPLACE,TAPE5=T562601.
RETURN,TAPE1,TAPE2,TAPE3,TAPE5,TAPE6,TAPE7.
RETURN,LGO.
```

TABLE 9. Listing of 'PLTFLE' with Procedure 'PLTFILE'

```
.PROC,PLTFILE.
GET,XX1=T562601.
GET,XX2=T563601.
GET,XX3=T562801.
GET,XX4=T562701.
GET,XX5=T562603.
GET,XX6=T562602.
GET,XX7=T562611.
GET,XX8=T562612.
GET,XX9=T56261.
GET,XX10=T56262.
GET,XX11=T563602.
GET,AA=READB2.
REWIND,AA,XX1,XX2,XX3,XX4,XX5,XX6.
REWIND,XX7,XX8,XX9,XX10,XX11.
AA.
RETURN,XX1,XX2,XX3,XX4,XX5,XX6.
REWIND,XXOUT.
RETURN,XX7,XX8,XX9,XX10,XX11,AA.
REPLACE,XXOUT.
RETURN,XXOUT.
```

APPENDIX

This page intentionally left blank.

```
      program co2
      real x626(18),x636(18),x628(18),x627(18),y(18),total(18)
      real x03301(18),x02201(18),x11101(18),x11102(18)
      real x10001(18),x10002(18),x63602(18)
      real sx(141),sy(141)
      INTEGER IC(18)
      character*10 id(8)

      open (unit=4,file='garbage')
      open (unit=8,file='co2data1')
      open (unit=9,file='data')

      do 400 n=1,141
         read(9,2)sy(n),sx(n)
2        format(f5.1,2x,e7.1)
400   continue

      do 200 j=1,18
         total(j)=0.0
200   continue

      alt=65.0
      do 100 i=1,18
         read(8,1)x626(i),x636(i),x628(i),x627(i),x03301(i),x02201(i),
     &             x11101(i),x11102(i),x10001(i),x10002(i),x63602(i)
1        format(11(1x,e10.5))
         total(i)=x626(i)+x636(i)+x628(i)+x627(i)+x03301(i)+x02201(i)+
     &             x11101(i)+x11102(i)+x10001(i)+x10002(i)+x63602(i)
         y(i)=alt
         alt=alt+5.0
100   continue

      DO 10 I=1,18
      IC(I)=1
   10 CONTINUE
      DO 20 I=1,18
      IF(X626(I).GE.9.0E-10) IC(1)=I
      IF(X636(I).GE.9.0E-10) IC(2)=I
      IF(X628(I).GE.9.0E-10) IC(3)=I
      IF(X627(I).GE.9.0E-10) IC(4)=I
      IF(X03301(I).GE.9.0E-10) IC(5)=I
      IF(X02201(I).GE.9.0E-10) IC(6)=I
      IF(X11101(I).GE.9.0E-10) IC(7)=I
      IF(X11102(I).GE.9.0E-10) IC(8)=I
      IF(X10001(I).GE.9.0E-10) IC(9)=I
      IF(X10002(I).GE.9.0E-10) IC(10)=I
      IF(X63602(I).GE.9.0E-10) IC(11)=I
      IF(TOTAL(I).GE.9.0E-10) IC(12)=I
   20 CONTINUE

      call pltid3(id,1,2,.7,0)
      call plot(2.2,6.0,-3)

      ymin=50.0
      dy=10.0
```

```
xmin=-9.
dx=1./3.
no_dec=5
zinc=3.

call lgaxis(0.,0.,'radiance',-8,15.,0.,xmin,dx,1.,no_dec,zinc)
call lgaxis(0.0,11.0,' ',1,15.0,0.0,xmin,dx,-1.,no_dec,zinc)
call axis(0.0,0.0,'tangent height',14,11.0,90.0,ymin,dy,2.0)
call axis(15.0,0.0,' ',-1,11.0,90.0,ymin,0.0,2.0)

call symbol(2.0,11.5,2.,'CARBON DIOXIDE RADIANCE PROFILE',0,31)

call lgline(sx,sy,141,1,-1,15,xmin,dx,ymin,dy,2,1,0)
call lgline(x626,y,IC(1),1,1,3,xmin,dx,ymin,dy,2,1,0)
call lgline(x636,y,IC(2),1,1,2,xmin,dx,ymin,dy,2,1,0)
call lgline(x628,y,IC(3),1,1,0,xmin,dx,ymin,dy,2,1,0)
call lgline(x627,y,IC(4),1,1,5,xmin,dx,ymin,dy,2,1,0)
call lgline(x03301,y,IC(5),1,1,4,xmin,dx,ymin,dy,2,1,0)
call lgline(x02201,y,IC(6),1,1,8,xmin,dx,ymin,dy,2,1,0)
call lgline(x11101,y,IC(7),1,1,13,xmin,dx,ymin,dy,2,1,0)
call lgline(x11102,y,IC(8),1,1,17,xmin,dx,ymin,dy,2,1,0)
call lgline(x10001,y,IC(9),1,1,6,xmin,dx,ymin,dy,2,1,0)
call lgline(x10002,y,IC(10),1,1,7,xmin,dx,ymin,dy,2,1,0)
call lgline(x63602,y,IC(11),1,1,9,xmin,dx,ymin,dy,2,1,0)
call lgline(total,y,IC(12),1,1,1,xmin,dx,ymin,dy,2,1,0)

call symbol(11.0,9.7,18.,'d',0,0)
call symbol(11.0,9.3,18.,'c',0,0)
call symbol(11.0,8.9,18.,'a',0,0)
call symbol(11.0,8.5,18.,'f',0,0)
call symbol(11.0,8.1,18.,'e',0,0)
call symbol(11.0,7.7,18.,'i',0,0)
call symbol(11.0,7.3,18.,'n',0,0)
call symbol(11.0,6.9,18.,'r',0,0)
call symbol(11.0,5.3,18.,'b',0,0)
call symbol(11.0,6.5,18.,'g',0,0)
call symbol(11.0,6.1,18.,'h',0,0)
call symbol(11.0,5.7,18.,'j',0,0)
call symbol(11.0,10.2,18.,'p',0,0)
call symbol(11.5,9.7,.09,'626  01101-00001',0,16)
call symbol(11.5,9.3,.09,'636  01101-00001',0,16)
call symbol(11.5,8.9,.09,'628  01101-00001',0,16)
call symbol(11.5,8.5,.09,'627  01101-00001',0,16)
call symbol(11.5,8.1,.09,'626  03301-02201',0,16)
call symbol(11.5,7.7,.09,'626  02201-01101',0,16)
call symbol(11.5,7.3,.09,'626  11101-10001',0,16)
call symbol(11.5,6.9,.09,'626  11102-10002',0,16)
call symbol(11.5,6.5,.09,'626  10001-01101',0,16)
call symbol(11.5,6.1,.09,'626  10002-01101',0,16)
call symbol(11.5,5.7,.09,'636  02201-01101',0,16)
call symbol(11.5,5.3,.09,'TOTAL',0,5)
call symbol(11.5,10.2,.09,'SPIRE DATA',0,10)

call endplt
end
```

```
      PROGRAM FIXSPIR(INPUT,OUTPUT)
      CHARACTER*80 HEADER
      CHARACTER*40 NAME
      NR=10
      NW=20
      OPEN(UNIT=NR, FILE='SPIREF')
      OPEN(UNIT=NW, FILE='SPIREH')
      READ(NR,80) HEADER
   80 FORMAT(A80)
      WRITE(NW,80) HEADER
      DO 10 I=65,190
      READ(NR,'(A40,F12.3)') NAME,A
      WRITE(NW,'(A39,3F12.3)') NAME,A,A,A
   10 CONTINUE
      CLOSE(NR)
      CLOSE(NW)
      END
```

```
      PROGRAM READFL(INPUT,OUTPUT)
      DIMENSION A(11,18),B(5),C(5)
      CHARACTER*100 D
      INTEGER KK(10)
      CHARACTER*7 NAME
      DO 110 IJK=1,11
      IF(IJK.EQ.1) NAME='XX1'
      IF(IJK.EQ.2) NAME='XX2'
      IF(IJK.EQ.3) NAME='XX3'
      IF(IJK.EQ.4) NAME='XX4'
      IF(IJK.EQ.5) NAME='XX5'
      IF(IJK.EQ.6) NAME='XX6'
      IF(IJK.EQ.7) NAME='XX7'
      IF(IJK.EQ.8) NAME='XX8'
      IF(IJK.EQ.9) NAME='XX9'
      IF(IJK.EQ.10) NAME='XX10'
      IF(IJK.EQ.11) NAME='XX11'
      OPEN(UNIT=10, FILE=NAME)
      DO 50 I=1,11
      READ(10,55,ERR=50,END=50) D
   55 FORMAT(A100)
   50 CONTINUE
      DO 90 J=1,3
      DO 10 I=1,1000
      READ(10,15,ERR=20,END=20) W,D,K,K,(KK(L),B(L),C(L),L=1,5)
   15 FORMAT(F7.2,A2,I5,I4,5(I4,E10.4,E9.3))
      IF(W.EQ.0.0) GOTO 20
      DO 25 L=1,5
      A(IJK,J*5-5+L)=B(L)
   25 CONTINUE
   10 CONTINUE
   20 CONTINUE
      DO 28 L=1,6
      READ(10,55,ERR=28,END=28) D
   28 CONTINUE
   90 CONTINUE
      DO 40 I=1,1000
      READ(10,45,ERR=60,END=60) W,D,K,K,(KK(L),B(L),C(L),L=1,3)
   45 FORMAT(F7.2,A2,I5,I4,3(I4,E10.4,E9.3))
      IF(W.EQ.0.0) GOTO 60
      DO 75 L=1,3
      A(IJK,15+L)=B(L)
   75 CONTINUE
   40 CONTINUE
   60 CONTINUE
      CLOSE(10)
  110 CONTINUE
      OPEN(UNIT=20, FILE='XXOUT')
      DO 70 I=1,18
      WRITE(*,'(11E11.5)') (A(IJK,I),IJK=1,11)
      WRITE(20,'(11E11.5)') (A(IJK,I),IJK=1,11)
   70 CONTINUE
      CLOSE(20)
      END
```

END

5-87

DTIC